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PNS/PAES 233 (2008) (English): Agricultural Machinery - Multicrop Washer-Peeler - Methods of Test



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# PHILIPPINE NATIONAL STANDARD

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## Agricultural Machinery – Multicrop Washer-Peeler – Methods of Test



DEPARTMENT OF  
TRADE & INDUSTRY  
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**National Foreword**

This Philippine Agricultural Engineering Standards PAES 233:2008, Agricultural Machinery – Multicrop Washer-Peeler – Methods of Test was approved for adoption as Philippine National Standard by the Bureau of Product Standards upon the recommendation of the Agricultural Machinery Testing and Evaluation Center.

## **Foreword**

The formulation of this national standard was initiated by the Agricultural Machinery Testing and Evaluation Center (AMTEC) through the project “Multicrop Processing Machines for ‘Commercialization’” funded by the Department of Science and Technology (DOST) through its Technology Innovation for Commercialization (TECHNICOM) Program and monitored by the Philippine Council for Agriculture, Forestry and Natural Resources Research Development (PCARRD).

This standard has been technically prepared in accordance with BPS Directives Part 3:2003 – Rules for the Structure and Drafting of International Standards.

This standard has been technically prepared for multicrop washer-peeler which is the main purpose is for washing but during operation partial peeling takes place.

The word “shall” is used to indicate mandatory requirements to conform to the standard.

The word “should” is used to indicate that among several possibilities one is recommended as particularly suitable without mentioning or excluding others.

In the preparation of this standard, the following documents/publications were considered:

AMTEC Test and Evaluation Report VISCA – PRCRTC Motor-Operated Root Crop Washer/Peeler

Bautista, O.K. and H.B. Aycardo. Ginger: Its Production, Handling, Processing and Marketing with Emphasis on Export. Department of Horticulture, College of Agriculture, University of the Philippines Los Baños. 1979.

Ginger and Garlic Processing.  
[http://mofpi.nic/projectprofiles/EDII\\_AHMD?Plantation\\_Spice\\_Products](http://mofpi.nic/projectprofiles/EDII_AHMD?Plantation_Spice_Products)

Ginger Crop Guides: Post Harvest Handling of Ginger.  
<http://www.agribusinessonline.com/crops/gingerph.asp>

Malinis, Arnulfo P., et al. Development of the Integrated Multi-Crop Processing System (Zero waste Ginger Processing Technology). 2004

Plotto, Anne. Post-production Management for Improved Markey Access for Herbs and Spices. [http://www.fao.org/inpho/content/compend/text/ch27/ch27\\_02.htm](http://www.fao.org/inpho/content/compend/text/ch27/ch27_02.htm)

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**Agricultural Machinery – Multicrop Washer-Peeler–Methods of Test**

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**1 Scope**

This standard specifies the methods of test and inspection for multicrop washer-peeler used for ginger, arrow root, sweet potato, potato, radish and carrots. Specifically, it shall be used to:

- 1.1 verify the mechanism, dimensions, materials, accessories of the multicrop washer-peeler and the list of specifications submitted by the manufacturer;
- 1.2 determine the performance of the machine;
- 1.3 evaluate the ease of handling and safety features; and
- 1.4 report the results of the tests.

**2 References**

The following normative documents contain provisions, which through reference in this text constitute provisions of these standards:

PAES 103:2000 Agricultural Machinery – Method of Sampling

PAES 232:2008 Agricultural Machinery – Multicrop Washer-Peeler- Specifications

**3 Definitions**

For the purpose of this standard, the definitions given in PAES 232 and the following shall apply:

**3.1****freshly harvested**

crop condition stored not more than 2 days after harvest

**3.2****holding capacity**

weight of input test material per batch, expressed in kilogram per batch

**3.3****labor requirement**

number of persons needed to operate the multicrop washer-peeler

**3.4****machine efficiency**

quantitative efficiency of the machine in cleaning and peeling crops, expressed in percent

**3.5****mechanically damaged materials**

materials that are damaged (i.e. bruises/scratched, broken, sliced, etc.) as a result of washing and peeling operation, expressed in percent

**3.6****operating time**

length of time measured from the time the prime mover was started until it was turned off

**3.7****overall height**

distance between the horizontal supporting surface and the horizontal plane touching the uppermost part of the multicrop washer-peeler

NOTE All parts of the multicrop washer-peeler projecting upwards are contained between these two planes.

**3.8****overall length**

distance between the vertical planes at a right angles to the median plane of the multicrop washer-peeler and touching its front and rear extremities

NOTE All parts of the multicrop washer-peeler, in particular, components projecting at the front and at the rear are contained between these two planes. Where an adjustment of components is possible, it shall be set at minimum length.

**3.9****overall width**

distance between the vertical planes parallel to the median plane of the multicrop washer-peeler, each plane touching the outermost point of the multicrop washer-peeler on its respective sides

NOTE All parts of the multicrop washer-peeler projecting laterally are contained between these two planes.

**3.10****running-in period**

preliminary operation of the machine to make final adjustments prior to the conduct of test

## 4 General Conditions for Test and Inspection

### 4.1 Selection of multicrop washer-peeler to be tested

Machine submitted for test shall be sampled in accordance with PAES 103.

### 4.2 Role of manufacturer/dealer

The manufacturer shall submit specifications and other relevant information about the multicrop washer-peeler and shall abide with the terms and conditions set forth by an official testing agency.

### **4.3 Role of the operator**

An officially designated operator shall be skilled and shall demonstrate, operate, adjust, and repair as the case maybe, related to the operation of the machine.

### **4.4 Test site conditions**

The site should have ample provisions for material handling, water supply, drainage, temporary storage and workspace and suitable for normal working condition.

### **4.5 Termination of Test**

If during testing, the machine stops due to major component breakdown or malfunctions, the test engineer from the official testing agency shall terminate the test.

## **5 Test Preparation**

### **5.1 Test instruments**

The instruments to be used shall have been calibrated and checked by the testing agency prior to the measurements. The suggested list of minimum field and laboratory test equipment and materials needed to carry out the multicrop washer-peeler test is shown in Annex A.

### **5.2 Test material**

Test materials to be used shall be any of the following crops; ginger, arrow roots, sweet potato, potato, radish and carrot with the following characteristics:

#### **5.2.1 Test material characteristics**

**5.2.1.1 Variety** : locally grown (as much as possible single variety)

**5.2.1.2 Condition** : freshly harvested

#### **5.2.1.3 Quantity to be supplied**

The amount of test material that will be used in performing the test shall be four times the holding capacity of the machine.

### **5.3 Sample Preparation**

Prepare the test material in such a way that the test sample for each trial shall have identical characteristics in terms of variety and condition and date of harvest. Care should be taken so as to prevent alterations of the conditions of the test materials.

### **5.4 Running-in and preliminary adjustment**

Before the start of the test, the multicrop washer-peeler should have undergone running-in period wherein various adjustments of the multicrop washer-peeler shall be made according to the recommendation of the manufacturer. No other adjustments shall be permitted while the test is on-going.

## **6 Pre-test Observation**

### **6.1 Verification of the manufacturer's technical data and information**

This inspection is carried out to verify the mechanism, dimensions, materials and accessories of the multicrop washer-peeler in comparison with the list of manufacturer's technical data and information.

**6.2** A plain and level surface shall be used as reference plane for verification of multicrop washer-peeler dimensional specifications.

**6.3** The items to be inspected and verified shall be recorded in Annex B.

## **7 Performance test**

This is carried out to obtain actual data on overall machine performance.

### **7.1 Operation of the multi-crop washer-peeler**

The multicrop washer-peeler shall be operated at the recommended settings of the manufacturer. After each test trial, the washing-peeling area shall be cleaned and then prepared for the next test trial.

### **7.2 Test Trial**

Each test trial shall be one complete cleaning operation per batch of test materials as determined by the operator.

### **7.3 Test Material Sampling**

#### **7.3.1 Sampling procedure for test materials**

Before the start of the test trials, randomly take approximately three (3) kilograms sample for determination of input material condition.

#### **7.3.2 Sampling from discharge chute**

Randomly take approximately one and one-half (1 ½) kilograms of sample from the discharge chute in each test trial to be analyzed in the laboratory for output material condition.

#### **7.3.3 Handling of Samples**

All samples shall be placed in appropriate containers, properly labeled and sealed.

### **7.4 Data Collection**

#### **7.4.1 Duration of Test**

The duration of each test trial shall start from loading to unloading of test material per batch.

#### **7.4.2 Noise level**

The noise emitted by the machine shall be measured using a noise level meter at the location of the operator and collector. The noise level shall be measured approximately 50 mm away from the ear level of the operator and collector.

### **7.4.3 Speed of Components**

The speed of the rotating shafts of the major components of the multicrop washer-peeler shall be taken using tachometer.

**NOTE** Measurements shall be taken with and without load for sub-clauses 7.4.2 and 7.4.3 as specified in Annex C. Measurements with load shall be randomly taken during the duration of each test trial.

### **7.4.4 Fuel/Power Consumption**

Before the start of each trial, the fuel tank shall be filled to its capacity for internal combustion engines used as power source. After each test trial the tank shall be refilled using graduated cylinder. The amount of refueling is the fuel consumption for the test. When filling up the tank, keep the tank horizontal so as not to leave empty space in the tank.

In case an electric motor is used as the prime mover, a power meter shall be used to measure electric energy consumption. Measurement shall be randomly taken during the duration of each test trial.

### **7.4.5 Water Requirement**

Before the start of each trial, the amount of water to be used shall be measured and recorded.

## **7.5 Data recording and observations**

Record sheet for all data and information during the test is given in Annex C.

## **8 Laboratory Analysis**

Laboratory analysis shall be made to determine input and output condition of test material. The laboratory test data sheet to be used is given in Annex D.

### **8.1 Determination of Input and Output Condition of Test Material**

#### **8.1.1 For Input Test Material**

**8.1.1.1** Manually wash the sample.

**8.1.1.2** Let the sample dry and weigh.

**8.1.1.3** Compute and record the weight of the soil-impurities present on the samples.

**8.1.1.4** Calculate the percent soil-impurities in the samples using the formula given in Annex E.

#### **8.1.2 For Output Test Material**

**8.1.2.1** Inspect and separate damaged samples.

**8.1.2.2** Weigh the damaged samples.

**8.1.2.3** Calculate the net damaged samples using the formula given in Annex E.

**8.1.2.4** Calculate the percent mechanically damaged samples using the formula given in Annex E.

## **8.2 Determination of Machine Efficiency**

Calculate the machine efficiency using the formula given in Annex E.

## **9 Formula**

The formulas to be used during calculations and testing are given in Annex E.

## **10 Test Report**

The test report shall include the following information in the order given:

**10.1** Title

**10.2** Summary

**10.3** Purpose and Scope of Test

**10.4** Methods of Test

**10.5** Description of the Machine

Table 1 – Machine Specifications

**10.6** Results and Discussions

**10.7** Observations (include pictures)

Table 2 –Performance test data

**10.8** Name/s, signature/s and designation of test engineers

**Annex A**  
(informative)

**Minimum List of Field and Laboratory  
Test Equipment and Materials**

<b>A.1</b>	<b>Equipment</b>	<b>Quantity</b>
<b>A.1.1</b>	<b>Field</b>	
<b>A.1.1.1</b>	Tachometer (contact type or photo electric type) Range: 0 rpm to 5,000 rpm	1
<b>A.1.1.2</b>	Digital timers (range: 60 minutes) Accuracy: 0.1 sec	2
<b>A.1.1.3</b>	Tape measure (with maximum length of 5m)	1
<b>A.1.1.4</b>	Noise level meter Range: 30 dB (A) to 130 dB (A)	1
<b>A.1.1.5</b>	Portable Digital (capacity: 100 kg) Scale divisions: 500 g or or weighing scale (capacity: 100 kg) Scale divisions: 500 g	1
<b>A.1.1.6</b>	Graduated cylinder (for engines) (500 ml capacity) or power meter (for electric motors) 60 Hz, 220 V	1
<b>A.1.1.7</b>	Vernier Caliper Accuracy: 0.1 mm	1
<b>A.1.1.8</b>	Camera	1
<b>A.1.2</b>	<b>Laboratory</b>	
<b>A.1.2.1</b>	Weighing scale (capacity: 1 kg) Sensitivity: 0.01 g	1
<b>A.1.2.2</b>	Basin with water	1
<b>A.2</b>	<b>Materials</b>	
<b>A.2.1</b>	Sample bags	
<b>A.2.2</b>	Labeling tags which include	
<b>A.2.2.1</b>	Date of test	
<b>A.2.2.2</b>	Multicrop washer-peeler on test	
<b>A.2.2.3</b>	Sample source	
<b>A.2.2.4</b>	Variety	
<b>A.2.2.5</b>	Trial number	

**Annex B**  
(informative)

**Specifications of Multicrop Washer-Peeler**

Name of Applicant/ Distributor: \_\_\_\_\_

Address: \_\_\_\_\_

Tel No: \_\_\_\_\_

Name of Manufacturer: \_\_\_\_\_

Address: \_\_\_\_\_

Tel No: \_\_\_\_\_

**GENERAL INFORMATION**

Make: \_\_\_\_\_ Type: \_\_\_\_\_

Serial No: \_\_\_\_\_ Brand/Model: \_\_\_\_\_

Production date of Multicrop Washer-Peeler to be tested: \_\_\_\_\_

Testing Agency: \_\_\_\_\_ Test Engineer: \_\_\_\_\_

Date of Test: \_\_\_\_\_ Location of Test: \_\_\_\_\_

**Items to be inspected**

ITEMS	Manufacturer's Specification	Verification by the Testing agency
<b>B.1</b> Main structure		
<b>B.1.1</b> Overall dimensions, mm		
<b>B.1.1.1</b> length		
<b>B.1.1.2</b> width		
<b>B.1.1.3</b> height		
<b>B.1.2</b> Weight, without engine (kg), if Applicable		
<b>B.2</b> Feeding port		
<b>B.2.1</b> Height from the ground, mm		
<b>B.2.2</b> Location		
<b>B.3</b> Power Transmission		
<b>B.3.1</b> Pulley		
<b>B.3.1.1</b> Prime mover		
<b>B.3.1.1.1</b> Type		
<b>B.3.1.1.2</b> Dimension, mm		
<b>B.3.1.2</b> Speed Reducer Input Shaft		
<b>B.3.1.2.1</b> Type		
<b>B.3.1.2.2</b> Dimension, mm		
<b>B.3.1.2.3</b> Speed Ratio		
<b>B.3.1.3</b> Speed Reducer Output Shaft		
<b>B.3.1.3.1</b> Type		
<b>B.3.1.3.2</b> Dimension, mm		
<b>B.3.1.3.3</b> Speed Ratio		
<b>B.4</b> Main Frame		
<b>B.4.1</b> Material		
<b>B.4.2</b> Thickness, mm		
<b>B.4.3</b> Dimension, mm		

<b>B.5</b>	Washing drum assembly		
<b>B.5.1</b>	Water Container		
<b>B.5.1.1</b>	Material		
<b>B.5.1.2</b>	Length, mm		
<b>B.5.1.3</b>	Diameter, mm		
<b>B.5.1.4</b>	Other features		
<b>B.5.2</b>	Washing drum		
<b>B.5.2.1</b>	Material		
<b>B.5.2.2</b>	Length, mm		
<b>B.5.2.3</b>	Diameter, mm		
<b>B.5.3</b>	Main Shaft		
<b>B.5.3.1</b>	Material		
<b>B.5.3.2</b>	Length, mm		
<b>B.5.3.3</b>	Diameter, mm		
<b>B.5.4</b>	Brush		
<b>B.5.4.1</b>	Material		
<b>B.5.4.2</b>	Length		
<b>B.5.4.3</b>	Diameter		
<b>B.5.4.4</b>	Tip Appearance		
<b>B.6</b>	Screen/Discharge Chute		
<b>B.6.1</b>	Material		
<b>B.6.2</b>	Frame		
<b>B.6.3</b>	Dimensions, mm		
<b>B.6.4</b>	Sieve/Mesh Number		
<b>B.6.5</b>	Inclination		
<b>B.7</b>	Prime mover		
<b>B.7.1</b>	Electric motor		
<b>B.7.1.1</b>	Brand		
<b>B.7.1.2</b>	Make or manufacturer		
<b>B.7.1.3</b>	Serial No.		
<b>B.7.1.4</b>	Type		
<b>B.7.1.5</b>	Rated Power, kW		
<b>B.7.1.6</b>	Rated Speed, rpm		
<b>B.7.1.7</b>	Frequency, Hz		
<b>B.7.1.8</b>	Voltage		
<b>B.7.1.9</b>	Weight, kg		
<b>B.7.2</b>	Engine		
<b>B.7.2.1</b>	Brand		
<b>B.7.2.2</b>	Model		
<b>B.7.2.3</b>	Make or manufacturer		
<b>B.7.2.4</b>	Serial No.		
<b>B.7.2.5</b>	Type		
<b>B.7.2.6</b>	Rated Power, kW		
<b>B.7.2.7</b>	Rated Speed, rpm		
<b>B.7.2.8</b>	Displacement (cm <sup>3</sup> )		
<b>B.7.2.9</b>	Cooling system		
<b>B.7.2.10</b>	Starting system		
<b>B.7.2.11</b>	Weight, kg		

**Annex C**  
(informative)

**Performance Test Data Sheet**

Test Trial No. \_\_\_\_\_  
 Test Engineer: \_\_\_\_\_  
 Assistants: \_\_\_\_\_  
 Test Requested by: \_\_\_\_\_

Date: \_\_\_\_\_  
 Location: \_\_\_\_\_  
 Test Specimen: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_

<b>C.1</b> Information on the Test Materials					
<b>C.1.1</b> Crop					
<b>C.1.2</b> Source					
<b>C.1.3</b> Condition					
<b>C.2</b> Result of Performance Test					
ITEMS	Trial 1	Trial 2	Trial 3	Ave.	
<b>C.2.1</b> Weight of Input, kg					
<b>C.2.2</b> Loading time, s					
<b>C.2.3</b> Weight of Output, kg					
<b>C.2.4</b> Unloading time, s					
<b>C.2.5</b> Holding Capacity, kg					
<b>C.2.6</b> Operating time, s					
<b>C.2.7</b> Washing capacity, kg/h					
<b>C.2.8</b> Rated Capacity, kg/h					
<b>C.2.9</b> Speed of Components, rpm					
<b>C.2.9.1</b> Electric Motor					
<b>C.2.9.1.1</b> Without load					
<b>C.2.9.1.2</b> With load					
<b>C.2.9.2</b> Input Reducer Shaft					
<b>C.2.9.2.1</b> Without load					
<b>C.2.9.2.2</b> With load					
<b>C.2.9.3</b> Output Reducer Shaft					
<b>C.2.9.3.1</b> Without load					
<b>C.2.9.3.2</b> With load					
<b>C.2.9.4</b> Main Shaft					
<b>C.2.9.4.1</b> Without load					
<b>C.2.9.4.2</b> With load					
<b>C.2.9.5</b> Prime mover Shaft					
<b>C.2.9.5.1</b> Without load					
<b>C.2.9.5.2</b> With load					
<b>C.2.10</b> Noise Level, dB(A)					
<b>C.2.10.1</b> Without load					
<b>C.2.10.2</b> With load					
<b>C.2.11</b> Power Consumption					
<b>C.2.11.1</b> Power, kW					
<b>C.2.11.1.1</b> Without load					

<b>C.2.11.1.2</b>	With load				
<b>C.2.11.2</b>	Voltage, V				
<b>C.2.11.2.1</b>	Without load				
<b>C.2.11.2.2</b>	With load				
<b>C.2.11.3</b>	Current, A				
<b>C.2.11.3.1</b>	Without load				
<b>C.2.11.3.2</b>	With load				
<b>C.2.12</b>	Fuel consumption				
<b>C.2.12.1</b>	Fuel time, h				
<b>C.2.12.2</b>	Fuel consumed, L				
<b>C.2.13</b>	Water consumption				
<b>C.2.13.1</b>	Water consumed, L				

**C.3 Rate the following observations:**

Items	Rating*				
	1	2	3	4	5
<b>C.3.1</b> Ease of loading					
<b>C.3.2</b> Ease of cleaning parts					
<b>C.3.3</b> Ease of adjusting and repair of parts					
<b>C.3.4</b> Ease of collecting output					
<b>C.3.5</b> Ease of transporting the machine					
<b>C.3.6</b> Safety					
<b>C.3.7</b> Vibration					

\*1 – Very good  
 2 - Good  
 3 - Satisfactory  
 4 - Poor  
 5 – Very poor

**C.4 Other Observations:**

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**Annex D**  
(informative)

**Laboratory Test Data Sheet**

Machine Tested: \_\_\_\_\_  
Analyzed by: \_\_\_\_\_

**D.1 Determination of Input and Output Condition of Test Material**

	Trial 1	Trial 2	Trial 3	General Average
<b>D.1.1 Mechanically Damaged Test material</b>				
D.1.1.1 Weight of input damaged samples, g				
D.1.1.2 Weight of output damaged samples, g				
D.1.1.3 Net of damaged samples, g				
D.1.1.4 Mechanically damaged, %				
<b>D.1.2 Soil-impurities Present in Test Material</b>				
D.1.2.1 Weight of soil-impurities present in input samples, g				
D.1.2.2 Weight of soil-impurities present in output samples, g				
D.1.2.3 Net of soil-impurities present in the samples, g				
D.1.2.4 Soil-impurities present in the samples, %				
D.1.2.5 Soil-impurities removed in the samples, %				

**Annex E**  
(informative)

**Formula Used During Calculations and Testing**

**E.1 Washing Capacity**

$$C_w = \frac{W_o}{T_o}$$

where:

$C_w$  = Washing Capacity, kg/h  
 $W_o$  = Total Weight of material, kg  
 $T_o$  = Operating time, h

**E.2 Net Damaged Samples, g**

$$D_n = \text{wt of output damaged samples, g} - \text{wt of input damaged samples, g}$$

**E.3 Mechanically Damaged Samples, %**

$$D_m = \frac{D_n}{W_i} \times 100$$

where:

$D_m$  = mechanically damaged samples, %  
 $D_n$  = Net damaged samples, g  
 $W_i$  = Total weight of sample, g

**E.4 Machine Efficiency, %**

$$Eff = \frac{Mr}{Mb} \times 100$$

$$Mr = Mb - Ma$$

$$Mb = \frac{W_{ii} - W_{if}}{W_{ii}} \times 100$$

$$Ma = \frac{W_{oi} - W_{of}}{W_{oi}} \times 100$$

where:

$Eff$  = Machine efficiency, %  
 $Mr$  = Soil-impurities removed from the samples, %  
 $Mb$  = Soil-impurities present in the samples, %  
 $W_{ii}$  = Initial weight of input sample, g  
 $W_{if}$  = Final weight of input sample after manual washing, g  
 $W_{oi}$  = Initial weight of output sample, g  
 $W_{of}$  = Final weight of output sample after manual washing, g  
 $Ma$  = Soil-impurities present in the output sample, %

## **E.5 Fuel/Electrical energy consumption**

### **E.5.1 Electrical energy consumption**

$$E_c = \frac{P_c T_o}{W_o}$$

where

$E_c$	=	Electrical energy consumption, kW-h/kg
$P_c$	=	Power consumed, kW
$T_o$	=	Time of operation, h
$W_o$	=	Total weight of test material, kg

### **E.5.2 Fuel consumption**

$$F_c = \frac{F_l}{T_o}$$

where:

$F_c$	=	Fuel consumption, L/h
$F_l$	=	Amount of fuel consumed, L
$T_o$	=	Time of operation, h